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June 25, 2004

International Bureau
World Intellectual Property Organization
34, chemin des Colombettes
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BY FACSIMILE
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Dear Sirs:

RE: ARTICLE 19 AMENDMENT

International Application No. PCT/CA03/02031

Title:	EXTERNAL COMBUSTION ROTARY PISTON ENGINE
Applicant:	James M. Conners
Intl. Filing Date:	30 December 2003
Our File No.:	42370-0002

Pursuant to Rule 46.1 PCT and Article 19 PCT, the Applicant requests that pages 26-31 of the present application be removed and that the amended pages of claims bearing the same numbers enclosed herewith be substituted therefor.

Pursuant to Rule 46.5 PCT, the applicant advises that, with this amendment:

(i) claims 2-7 and 10-20 are unchanged
(ii) claims 1, 8 and 9 replace claims 1, 8 and 9 as filed

A second set of marked-up pages, wherein all matter contained within square brackets has been deleted by the present amendment, and all underlined matter has been inserted by the present amendment, is also enclosed so as to draw attention to the differences between the replaced sheets and the replacement sheets.

The Applicant respectfully declines to avail himself of the opportunity to file the statement referred to in Article 19(1).

Further prosecution is earnestly and respectfully requested.

Yours very truly,

RIDOUT & MAYBEE LLP

Steven H. Leach

For the applicant

SHL/ms

cc. by registered mail, P.O. Box 18, 1211 Geneva 20, Switzerland
(replacement pages forwarded in triplicate)

CLAIMS

1. An engine for use with a load, said engine comprising:

a compressor adapted to receive power and, upon receiving power, to: periodically define a chamber; fill the chamber with ambient air; and carry out a pressurization process wherein the chamber volume is decreased to produce pressurized air,

a radiator adapted to receive pressurized air from the compressor and upon receiving pressurized air, to cool it such that less work is required to produce the pressurized air,

combuster means for receiving fuel and combusting same in a combustion process with the pressurized air to produce primary exhaust products,

a positive displacement air motor adapted to be driven by the primary exhaust products to produce power and secondary exhaust products,

a positive displacement gas expander for receiving the secondary exhaust products and expanding same substantially adiabatically to produce tertiary exhaust products and power, and

power transfer means for directing power produced by the air motor and the gas expander in use to drive the compressor and the load,

wherein:

the combuster means is adapted to receive varying amounts of fuel, thereby to cause the power transfer means to drive the load with varying amounts of power in use; and

the compressor is adapted to, during the pressurization process, release air from the chamber for said combustion in a manner such that the pressure in the chamber during the pressurization process and the pressure of the primary exhaust products driving the air motor is at a substantially constant level at steady state conditions, said level adjusting spontaneously to the load being driven by the power.

2. An engine according to claim 1, wherein the compressor is a rotary compressor.

3. An engine according to claim 1, wherein the combuster means comprises a tubular combuster.

4. An engine according to claim 1, wherein the air motor is a rotary air motor.

5. An engine according to claim 1, wherein the gas expander is a rotary gas expander.

6. An engine according to claim 1, wherein the power transfer means comprises a shaft operatively coupled to each of the compressor, the air motor and the gas expander.

7. An engine according to claim 1, further comprising a reservoir adapted to receive pressurized air from the compressor and wherein the combuster means receives air for said combustion from the reservoir.

8. An engine according to claim 1, wherein the radiator also serves as a reservoir adapted to receive pressurized air from the compressor and wherein the combuster means receives air for said combustion from the radiator.

9. An engine according to claim 2, wherein the radiator also serves as a reservoir adapted to receive pressurized air from the compressor and wherein the combuster means receives air for said combustion from the radiator.

10. An engine according to claim 1, wherein the expansion ratio defined by the expander is larger than the compression ratio defined by the compressor.

11. An internal combustion engine for use with a load, said engine comprising:

a rotary compressor adapted to receive power and, upon receiving power, to: periodically define a chamber; fill the chamber with ambient air; and carry out a pressurization process wherein the chamber volume is decreased to produce pressurized air,

a radiator coupled to the compressor to receive the pressurized air and adapted to cool said pressurized air and to function as a reservoir therefor,

a first backflow preventer and a second backflow preventer, each coupled to the radiator to permit unidirectional flow therefrom;

a pressure tank coupled to the first backflow preventer to receive pressurized air from the radiator;

a valve coupled to the pressure tank to permit the selective release of pressurized air from the pressure tank;

a tubular combuster coupled to the valve and to the second backflow preventer to receive pressurized air from the radiator and pressurized air selectively released from the pressure tank and adapted to receive fuel and combust same in a combustion process with the pressurized air so received to produce primary exhaust products,

a positive displacement rotary air motor coupled to the combuster so as to be driven by the primary exhaust products to produce power and secondary exhaust products,

a positive displacement rotary gas expander coupled to the air motor for receiving the secondary exhaust products and expanding same substantially adiabatically to produce tertiary exhaust products and power, and

a shaft operatively coupled to each of the compressor, the air motor and the gas expander for directing power produced by the air motor and the gas expander in use to drive the compressor and the load,

wherein:

the combuster means is adapted to receive varying amounts of fuel, thereby to cause the power transfer means to drive the load with varying amounts of power in use; and

the compressor is adapted to, during the pressurization process, release air from the chamber for said combustion in a manner such that the maximum pressure in the chamber during the pressurization process and the pressure of the primary exhaust products driving the air motor is substantially constant at steady state conditions, said constant being a function of the power driving the load.

12. An engine according to claim 1, wherein the expansion ratio defined by the expander is larger than the compression ratio defined by the compressor.

13. An engine according to claim 1, wherein the compressor is a three stage compressor.

14. A device for transferring power between a rotatable shaft and a source of gas, said device comprising:

housing means for defining a pair of fluid ports and a piston chamber in fluid communication with each of the fluid ports,

a multilobe piston mounted in said piston chamber for rotation about a first axis and couplabe in use to said shaft to provide for rotation of one of said piston and said shaft upon rotation of the other; and

a pair of gate rotors mounted in said piston chamber for rotation each about a respective second axis, in sealing contact against said piston and coupled to said piston to provide for rotation of one of said piston and said gate rotors upon rotation of the other, said gate rotors having sockets therein to receive the lobes during said rotation,

the piston and the gate rotors dividing the piston chamber into multiple subchambers of changing volume as the piston and rotors rotate, said subchambers being in communication with the fluid ports in a manner which permits operation of the device: as a compressor upon coupling one of the fluid ports to a source of fluid to be compressed and coupling the piston to a drive shaft; and as an expander upon coupling the one fluid port to a source of fluid to be expanded,

wherein the first axis and the second axes are parallel to one another, and wherein the second axes are 180° apart from one another relative to the first axis.

15. A device according to claim 14, wherein each gate rotor has two sockets located 180° apart from one another relative to the second axis about which said each gate rotor rotates, and wherein the piston has four lobes located 90° apart from one another relative to the first axis

16. A device according to claim 14, in use as the positive displacement gas expander in the engine of claim 12.

17. A device according to claim 14, in use as the positive displacement air motor in the engine of claim 12.

18. A device according to claim 14, in use as the first compression stage in the engine of claim 13.

19. A device according to claim 14, in use as the second compression stage in the engine of claim 13.

20. A device according to claim 14, wherein each gate rotor has four sockets located 90° apart from one another relative to the second axis about which said each gate rotor rotates, and wherein the piston has eight lobes located 45° apart from one another relative to the first axis.

CLAIMS

1. An engine for use with a load, said engine comprising:

a compressor adapted to receive power and, upon receiving power, to: periodically define a chamber; fill the chamber with ambient air; and carry out a pressurization process wherein the chamber volume is decreased to produce pressurized air,

a radiator adapted to receive pressurized air from the compressor and upon receiving pressurized air, to cool it such that less work is required to produce the pressurized air,

combuster means for receiving fuel and combusting same in a combustion process with the pressurized air to produce primary exhaust products,

a positive displacement air motor adapted to be driven by the primary exhaust products to produce power and secondary exhaust products,

a positive displacement gas expander for receiving the secondary exhaust products and expanding same substantially adiabatically to produce tertiary exhaust products and power, and

power transfer means for directing power produced by the air motor and the gas expander in use to drive the compressor and the load,

wherein:

the combuster means is adapted to receive varying amounts of fuel, thereby to cause the power transfer means to drive the load with varying amounts of power in use; and

the compressor is adapted to, during the pressurization process, release air from the chamber for said combustion in a manner such that the [maximum] pressure in the chamber during the pressurization process and the pressure of the primary exhaust products driving the air motor is at a substantially constant level at steady state conditions, said [constant being a function of] level adjusting spontaneously to the load being driven by the power.

2. An engine according to claim 1, wherein the compressor is a rotary compressor.

3. An engine according to claim 1, wherein the combuster means comprises a tubular combuster.

4. An engine according to claim 1, wherein the air motor is a rotary air motor.

5. An engine according to claim 1, wherein the gas expander is a rotary gas expander.

6. An engine according to claim 1, wherein the power transfer means comprises a shaft operatively coupled to each of the compressor, the air motor and the gas expander.

7. An engine according to claim 1, further comprising a reservoir adapted to receive pressurized air from the compressor and wherein the combuster means receives air for said combustion from the reservoir.

8. An engine according to claim [7]1, wherein the [reservoir is a] radiator [for cooling the pressurized air produced by the compressor] also serves as a reservoir adapted to receive pressurized air from the compressor and wherein the combuster means receives air for said combustion from the radiator.

9. An engine according to claim [1, further comprising means for cooling the pressurized air produced by the compressor prior to combustion] 2, wherein the radiator also serves as a reservoir adapted to receive pressurized air from the compressor and wherein the combuster means receives air for said combustion from the radiator.

10. An engine according to claim 1, wherein the expansion ratio defined by the expander is larger than the compression ratio defined by the compressor.

11. An internal combustion engine for use with a load, said engine comprising:

a rotary compressor adapted to receive power and, upon receiving power, to: periodically define a chamber; fill the chamber with ambient air; and carry out a pressurization process wherein the chamber volume is decreased to produce pressurized air,

a radiator coupled to the compressor to receive the pressurized air and adapted to cool said pressurized air and to function as a reservoir therefor,

a first backflow preventer and a second backflow preventer, each coupled to the radiator to permit unidirectional flow therefrom;

a pressure tank coupled to the first backflow preventer to receive pressurized air from the radiator;

a valve coupled to the pressure tank to permit the selective release of pressurized air from the pressure tank;

a tubular combuster coupled to the valve and to the second backflow preventer to receive pressurized air from the radiator and pressurized air selectively released from the pressure tank and adapted to receive fuel and combust same in a combustion process with the pressurized air so received to produce primary exhaust products,

a positive displacement rotary air motor coupled to the combuster so as to be driven by the primary exhaust products to produce power and secondary exhaust products,

a positive displacement rotary gas expander coupled to the air motor for receiving the secondary exhaust products and expanding same substantially adiabatically to produce tertiary exhaust products and power, and

a shaft operatively coupled to each of the compressor, the air motor and the gas expander for directing power produced by the air motor and the gas expander in use to drive the compressor and the load,

wherein:

the combuster means is adapted to receive varying amounts of fuel, thereby to cause the power transfer means to drive the load with varying amounts of power in use; and

the compressor is adapted to, during the pressurization process, release air from the chamber for said combustion in a manner such that the maximum pressure in the chamber during the pressurization process and the pressure of the primary exhaust products driving the air motor is substantially constant at steady state conditions, said constant being a function of the power driving the load.

12. An engine according to claim 1, wherein the expansion ratio defined by the expander is larger than the compression ratio defined by the compressor.

13. An engine according to claim 1, wherein the compressor is a three stage compressor.

14. A device for transferring power between a rotatable shaft and a source of gas, said device comprising:

housing means for defining a pair of fluid ports and a piston chamber in fluid communication with each of the fluid ports,

a multilobe piston mounted in said piston chamber for rotation about a first axis and couplabe in use to said shaft to provide for rotation of one of said piston and said shaft upon rotation of the other; and

a pair of gate rotors mounted in said piston chamber for rotation each about a respective second axis, in sealing contact against said piston and coupled to said piston to provide for rotation of one of said piston and said gate rotors upon rotation of the other, said gate rotors having sockets therein to receive the lobes during said rotation,

the piston and the gate rotors dividing the piston chamber into multiple subchambers of changing volume as the piston and rotors rotate, said subchambers being in communication with the fluid ports in a manner which permits operation of the device: as a compressor upon coupling one of the fluid ports to a source of fluid to be compressed and coupling the piston to a drive shaft; and as an expander upon coupling the one fluid port to a source of fluid to be expanded,

wherein the first axis and the second axes are parallel to one another, and wherein the second axes are 180° apart from one another relative to the first axis.

15. A device according to claim 14, wherein each gate rotor has two sockets located 180° apart from one another relative to the second axis about which said each gate rotor rotates, and wherein the piston has four lobes located 90° apart from one another relative to the first axis

16. A device according to claim 14, in use as the positive displacement gas expander in the engine of claim 12.

17. A device according to claim 14, in use as the positive displacement air motor in the engine of claim 12.

18. A device according to claim 14, in use as the first compression stage in the engine of claim 13.

19. A device according to claim 14, in use as the second compression stage in the engine of claim 13.

20. A device according to claim 14, wherein each gate rotor has four sockets located 90° apart from one another relative to the second axis about which said each gate rotor rotates, and wherein the piston has eight lobes located 45° apart from one another relative to the first axis.